Problem I: [20 pts.] Phasor Representation

Given the following circuit:

\[
\begin{align*}
&15 \, \Omega & \quad v_x \\ &1 \, \text{mH} & \quad 1 \, \mu F & \quad 2 \, \mu F & \quad 35 \, \Omega \\ &i_b & \quad v_a & \quad 20 \, \Omega \\ &5v_x & \quad i_y \\
\end{align*}
\]

and the fact that:

\[
v_a(t) = 2 \cos(32000t + 90^\circ) \, \text{V} \quad i_b(t) = 3 \sin(32000t - 22^\circ) \, \text{A}
\]

draw the phasor representation. Make sure to convert all possible components and represent all impedances and independent sources numerically. Use the blank circuit template on the next page to present your answer.
Name (please print):
Honor Code (please initial):

Problem II: [20 pts.] Complex Numbers

Given the following complex numbers:

\[ A = 8.485 \angle 45^\circ \quad B = 2e^{j11\pi/6} \quad C = 12 - j5 \]

(1) Fill in the following chart:

<table>
<thead>
<tr>
<th></th>
<th>Real Part</th>
<th>Imag. Part</th>
<th>Magnitude</th>
<th>Angle (deg)</th>
<th>Angle (rad)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>B</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

(2) Calculate the following:

(a) \[ A^* - \frac{B+C}{A} \] in polar notation

(b) \[ \frac{A}{|A|} + \frac{B}{|B|} + \frac{C}{|C|} \] in Euler notation

(c) \[ A \bar{C} - \bar{B}B \] in Cartesian notation
Problem III: [15 pts.] Differential Equations I

Determine and accurately plot the solution to the following first-order initial condition problem:

\[ 5\frac{dx(t)}{dt} + 2x(t) = 8 \]
\[ x(0) = 1 \]

To get full credit, you must indicate construction lines for getting the values and slopes for three time constants.
Name (please print):
Honor Code (please initial):

**Problem IV: [15 pts.] Differential Equations II**

Determine the solution to the following first-order initial condition problem:

\[
\frac{dy(t)}{dt} + 3y(t) = 3e^{-3t} - 2e^{-2t} + 27t^2 \\
y(0) = -4
\]
Problem V: [30 pts.] Switched Circuits

Given the following circuit:

and known values

\[ i_a = 1 \text{mA} \quad i_b = -2 \text{mA} \quad L_1 = 400 \text{mH} \]
\[ R_1 = 1 \text{k}\Omega \quad R_2 = 1 \text{k}\Omega \quad R_3 = 1 \text{k}\Omega \]

solve for the value of the current \( i_a(t) \) for \( t > 0 \). You must substitute numbers in for element and source values. Assume that the switch has been open for a very long time before it is closed. You do not have to graph the solution. **Hint 1:** Remember that you will want to solve in terms of the state variable first, then relate the state variable to your unknown later. **Hint 2:** You should have a first-order differential equation with a constant forcing function; you should also be able to easily determine the initial and final values of the state variable.